ON-SITE SOILS

I. Summary:

Based on samples collected during both the FI and previous investigations, and as discussed in Section 5.0 and Appendix A, COCs are present in some on-site soils above risk-based screening levels for both the direct exposure and vapor intrusion pathways. Direct contact would include those exposures related to immediate or near contact with soils: inhalation of dust or vapors, absorption through the skin or mucous membranes, and ingestion of soils. Vapor intrusion exposures would result from the evaporation of volatile COCs from the soils, and the subsequent accumulation of vapors in indoor air spaces used by personnel. The COCs that are present in on-site soils at concentrations above direct contact RBCs are dieldrin, dinoseb, and aldrin; the COCs exceeding vapor intrusion RBCs are chloroform and 1,2-dichloroethane (1,2-DCA). Figure 3 (vapor intrusion) and 4 (direct contact) illustrate the locations where these exceedances are present.

Most of these soil exceedances underlie the Process Areas of the Facility, although there are a few in other areas. Within the Process Areas, these exceedances exhibit a generally scattered distribution. This distribution is consistent with these COCs having been sourced from multiple releases at different locations within the Facility.

Despite the generally scattered distribution of COCs at elevated concentrations, there is a significant locus of exceedances in the vicinity of the Former Dinoseb Disposal Ponds, near the Pump Shop. In addition, Perched Zone groundwater exhibits the highest observed concentrations of 1,2-DCA beneath the former Dichloroaniline Unit (Unit 6) (Figure 5), which indicates the likely presence of elevated 1,2-DCA in soils beneath this unit.

Given the suspected nature of Facility releases (i.e., multiple releases from varied source areas) it is likely that there are localized areas of elevated COCs in soils across the Facility, including areas not previously observed during historical or recent investigative work. The potential presence of such “pockets” of elevated COCs should be considered during the remedy evaluation and selection process.

II. Alternatives Considered:

The following remedy alternatives were evaluated for soils:

Soil Remedy Alternative S1 – Exposure Controls

An exposure control approach is not intended to remove or destroy COCs in soils. Instead, it is intended to prevent current and future exposure pathways from becoming complete. Although the COCs would still be present, the public and site workers would not be exposed to harmful levels of these COCs. Exposure control would be achieved through a combination of engineering and institutional controls, as follows:

- A soil cover consisting primarily of asphalt pavement, which will be constructed across the Process Area. Following demolition of the above ground portions of site buildings and process units (see Section 7.0 of this FS), and the plugging of storm drains and other underground structures, the Process Area will be covered with a surface of asphalt pavement, including any needed base material. This pavement will be constructed in a manner that is suitable for normal commercial and industrial vehicle traffic, including semi-tractor trucks. The pavement will be continuous with foundations and related concrete structures that are left in place post-demolition. In addition, any significant breaches in the integrity of existing foundations, pads, or other concrete structures within the cover footprint will be repaired as a part of cover construction. The pavement and existing at-grade concrete structures together will comprise the soil cover in the Process Area. The anticipated footprint of this cover is shown on Figure 7.

- A soil cover consisting of geotextile overlain with approximately one foot of clean, low permeability soils, which will line the storm water collection ditch area on the southeast portion of the process areas (Figure 7). This geotextile/soil cover will be graded to maintain drainage to the south, and revegetated. Until revegetation is complete, the area will be monitored for excessive erosion, and repaired as needed.

- Institutional controls, including deed notices, ordinances, restrictive covenants, and other applicable measures, that would:

  i. Provide information to potential future buyers of the Facility property of the presence and location of soil COCs.
  ii. Limit the use of the Facility property to commercial/industrial activities, and prohibit certain non-industrial commercial uses (e.g., health care or children's day care) that would create an unacceptable risk scenario.
  iii. Require the installation and maintenance of site control and security measures, such as fencing, to limit public access to the Facility property. These institutional controls would also limit activities that could disturb either the soils or the cover described above. Require the prompt and complete repair of any disturbance of the soil cover
  iv. For any activity that would involve soil disturbance, require:

     — Characterization of the levels of COCs in soil or water that would be contacted during the disturbance activity.

     — The utilization of personnel, equipment, and methods appropriate for work with soils containing those COCs.

     — The management of soils, waters, or similar wastes generated from such activities in a manner that complied with state and federal regulations.

  v. Impose requirements for any new construction where there is the potential for unacceptable vapor intrusion risks. Within these areas, the design and construction of any new buildings or similar enclosed structures would have to include controls to limit the intrusion and accumulation of VOC vapors from underlying soils. The controls could include, but would not be limited to:

     — An assessment of soil vapor levels at the specific location of the planned structure,

— The construction of passive venting systems for crawlspaces, the exclusion of basements, and/or

— The use of vapor barriers and VOC sensor/alarm systems.

As depicted in Figure 7, these institutional controls would be implemented across the entirety of the Facility property, with the exception of the wooded area west of the Wastewater Treatment Ponds.

Soil Remedy Alternative S2 –*In Situ* Stabilization

The *in situ* stabilization (ISS) approach is not intended to remove or destroy COCs in soils, although some loss of VOCs from evaporation during soil mixing is a common ancillary effect of this remedy. Instead, ISS is intended to reduce the leachability and mobility of COCs in soil. With their mobility reduced, COCs are less likely to migrate from soils to groundwater, effectively reducing the source of groundwater impact. Stabilized soils also typically pose a lower risk than unstabilized soils with respect to both vapor intrusion and direct exposure.

ISS would require the removal of all surface improvements (including foundations), pavements, utilities, and other infrastructure in the areas to be treated. Once this removal is completed, soils would be excavated and mixed with a stabilizing material (the stabilant) using specially-equipped augers, trackhoes, or other equipment. This mixing would be performed primarily within the boundaries of the soil excavation. The stabilant may be fly ash, Portland cement, or another pozzolanic material. The preferred stabilant and mix ratios to meet remedial goals would be determined as a part of the Remedial Design process (see Section 10.0). Excavation and mixing would extend to approximately the top of the Perched Zone, at a typical depth of 17 feet.

At the conclusion of ISS, soils would be graded for desired drainage and remain in place within the excavation. Note that ISS often results in a slight volumetric increase in soil volume, so there may be a slight increase in the ground surface elevation within the ISS area.

At the Facility, ISS could be performed as either an area-wide or a focused approach. These differ as follows:

- Area-wide approach – This approach would address the entire Process Area portion of the Facility, as shown on Figure 8A.
- Focused approach – This approach would target specific areas (“hot spots”) known to represent areas of waste disposal or elevated COCs, and stabilize those areas. For example, as shown on Figure 8B, ISS would target the Former Dinoseb Disposal Pond area. This approach would not attempt to address all areas of soil contamination at the Facility, but to immobilize a large fraction of the soil COCs through the stabilization of a geographically defined source area.
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Soil Remedy Alternative S3—Excavation with Off-Site Disposal as Solid Waste

Excavation with off-site disposal permanently removes soil COCs from the Facility, through bulk removal of contaminated soils and their permanent placement in an off-site disposal facility. Excavation with off-site disposal would require the removal of all surface improvements (including foundations), pavements, utilities, and other infrastructure. Once this removal is completed, soils would be excavated and segregated by waste classification (i.e., hazardous vs. non-hazardous). Hazardous and non-hazardous waste soils would remain segregated through the remainder of the remedy process. Soils would be transferred to container trucks and transported from the site to licensed hazardous and non-hazardous solid waste disposal facilities. Excavation would extend to approximately the top of the Perched Zone, at a typical depth of 17 feet.

Soils from the sidewalls of the resulting excavation would be analyzed at completion to confirm that cleanup objectives had been met, with additional excavation as necessary to address any locations identified to still have elevated COCs. As soil removal was completed, the excavation would be backfilled with clean fill. This fill would have to be purchased and imported from a local supplier, since there is no on-site source of backfill. Backfill would be graded for desired drainage.

Like ISS, excavation could be performed in either an area-wide or a focused “hot spot” approach. These differ as follows:

- Area-wide approach – This approach would address the entire Process Area portion of the Facility, as shown on Figure 9A.
- Focused approach – This approach would target specific areas (“hot spots”) known to represent areas of waste disposal or elevated COCs, and remove soils from those areas. For example, as shown on Figure 9B, excavation would target the Former Dinoseb Disposal Pond area. This approach would not attempt to address all areas of soil contamination at the Facility, but to remove a large fraction of the soil COCs through the excavation of a geographically defined source area.

Soil Remedy Alternative S4—Soil Vapor Extraction

Soil vapor extraction, or SVE, utilizes wells or trenches to extract the air that fills much of the pore space in soils above the water table. As this air is withdrawn, vapor-phase COCs contained in the air are also removed. This removal will continue as evaporation of COCs in the subsurface transfers more chemical mass into the air being removed. SVE is most effective in relatively permeable material, and on volatile chemicals. Ancillary reductions of semi-volatile organics are sometime observed due to biologic action, however, in cases where SVE increases the oxygen content in soil gas.

The primary objective of SVE would be to improve groundwater quality by reducing the mass of VOCs that could ultimately reach Perched Zone and Alluvial Aquifer groundwater. SVE would also reduce vapor intrusion risks at the Facility, by reducing the mass of VOCs that behave as a source of organic vapors.

Given the primary objective cited above, SVE would be performed at locations with elevated VOCs either in soils or in the underlying Perched Zone groundwater (we are assuming that areas with elevated VOCs in Perched Zone groundwater are likely to be overlain by elevated VOCs in soils). The SVE system configuration under this area-wide approach is shown on Figure 10A. Alternatively, Figure 10B depicts how SVE could be focused on areas of elevated 1,2-DCA, in particular, rather than on volatile COCs in general. Under this focused approach, the SVE work would be concentrated in two areas based on Perched Zone groundwater levels of 1,2-DCA: at the former Unit 6, and at the former Unit 4 and 5 area.

Based on the shallow depth to water and high clay content of soils at this location, SVE will utilize a close extraction well spacing and relatively low vacuum pressures. For the purposes of this FS, a well spacing of approximately 20 feet and vacuums of approximately 40 inches of water are assumed. The extraction wells will be manifolded to the suction side of an extraction/treatment unit. Water condensing from the extracted vapor will be routed via a moisture knockout system to an aboveground tank. This water will be periodically collected for discharge to the Publicly Owned Treatment Works (POTW) intake at the Facility, subject to approval by the POTW operator.

Depending on the mass and character of VOCs removed and emitted to the atmosphere, it may be necessary to obtain an air emissions permit and/or perform emissions treatment in order to operate an SVE system. Emissions treatment options include activated carbon or thermal oxidation with scrubbing. The need for permitting and emissions treatment is more likely with larger systems (i.e., with the area-wide approach), since most emissions criteria are mass-based, with thresholds set in terms of tons of pollutant per year or pounds of pollutant per day.

The actual system specifications and operating parameters will be developed as a part of Remedial Design (discussed in Section 10.0). This will include any pilot testing and other activities needed to develop a final system design, as well as operating protocols.

Soil Remedy Alternative S5—No Further Action

Under a No Further Action (NFA) approach, no remedy would be implemented to address COCs in soils. Soils would be left in their existing condition, with no additional measures taken to reduce COC concentrations, and no controls implemented to limit potential public exposure to the soils, or to vapor intrusion risks associated with the soils.

III. Evaluation of Alternatives:

Soil Remedy Alternative S1 – Exposure Controls

Once started, the engineering controls (soil cover and geotextile/soil cover) could be implemented using conventional construction techniques over an estimated period of three months. Construction of these controls cannot be started, however, until demolition of site structures is complete. It may be further delayed if remedy alternatives are selected that would include excavation or other disturbance of the areas planned for the soil cover and soil/geotextile cover. Since all of the institutional controls described above would affect onproperty areas only, no negotiation or other interaction with other property owners would be required for their implementation. Given this, these institutional controls could presumably be rapidly put into place.

The primary purpose of these controls is to reduce the potential for direct contact to soils by workers and other potential receptors, and reducing the potential for vapor-intrusion exposures in future construction. Both engineering and institutional controls would become effective in controlling exposures immediately upon implementation, and would remain effective as long as they were maintained. They would therefore be effective over both the short and long term.

In addition to controlling direct contact and vapor intrusion risks, the engineering controls (soil cover and geotextile) would likely have the added benefits of:

- Improving storm water runoff quality, which would simplify the future management of storm water at the Facility.

- Reducing the infiltration of storm water through shallow soils, which would, in turn, reduce the flux of soil COCs to the Perched Zone and Alluvial Aquifer and help to reduce the concentrations of these COCs in groundwater.

In order to maintain the effectiveness of the engineering controls, regular inspections would be required, as well as avoiding activities that could damage the soil cover or geotextile, and repairing any such damage that may occur. The need to avoid damage to the soil cover would also potentially limit the types of construction activities that could occur in these areas of the site, and therefore preclude certain types of reuse.

The cost to implement soil exposure control is approximately $3.0 Million. This includes costs for legal preparation and filings and related engineering work to implement institutional controls, which is assumed to be $25,000. Costs to maintain engineering controls were calculated to be $5,000 per year, although these costs will depend on many variables that are difficult to predict. At the conclusion of the remedy period, we assume that the soil cover and geotextile would be left in place; no decommissioning costs would therefore be requireed for these engineering controls. The removal of institutional controls would be largely a legal exercise, and is assumed to cost $15,000.

Please note that these costs do not include the demolition and removal of the aboveground portions of site structures, since these costs are addressed in another remedy element specific to demolition. They also do include any costs for long term groundwater monitoring, as these costs are addressed in remedy alternatives that describe monitored natural attenuation.

A breakdown of these implementation, annual, and decommissioning costs is provided in Appendix B.

Soil Remedy Alternative S2 –*In Situ* Stabilization

ISS could be completed under an area-wide approach over a period of approximately 14 months, but could not commence until demolition and other remedy-related activities were completed across the Process Area. If the focused approach was utilized, the work area would be much smaller, and the timeframe would be much shorter—approximately 4 months.

Assuming the stabilant and mix ratios were effective in stabilizing the soils, this approach should reduce the leachability and mobility of soil COCs immediately upon completion. This effect should continue for several decades, depending on the stabilant used. ISS will likely not, however, result in an immediate reduction in groundwater COC levels.

Such a reduction should occur, but may require a period of years to observe in the Perched Zone, and even longer in the Alluvial Aquifer.

Stabilized soils may pose less of a threat through direct exposure to future site workers and other receptors, since COCs are more firmly "bound" to the soil particles, and may therefore be less capable of migrating from the stabilized soils to receptors via skin absorption, dust generation, etc. This magnitude of this reduction is, however, difficult to predict until treatability tests are completed.

It should also be noted that ISS will not be effective in immobilizing or otherwise treating soil COCs outside the specific area where it is performed. There are localized areas, such as in the vicinity of the former laboratory (Figure 3) where elevated COCs are present. Under either the area-wide or focused "hot spot" approach, these localized areas would remain in place unchanged. Unless all of the areas exhibiting elevated soil COC levels at the Facility are stabilized, therefore, soil COCs will remain present as potential sources of groundwater contamination.

In summary, ISS would have both good short term and long term effectiveness in reducing the direct contact and vapor intrusion risks posed by soil COCs in the treatment area. It would have low short term effectiveness, but good long term effectiveness in improving groundwater quality at the site. This remedy will have to be maintained in perpetuity to continue to be effective. If the stabilant used begins to break down over time, therefore, it may be necessary to repeat the ISS process to maintain the effectiveness of the remedy.

The cost to perform ISS under the area-wide approach depicted on Figure 8A is approximately $8.7 Million, and under the focused "hot spot" approach depicted in Figure 8B is approximately $2.1 Million. Note that these costs do not include the costs of removing buildings and aboveground structures, since those demolition costs are addressed as a part of another remedy element (see Section 7.0 of this FS). These costs do include, however, the removal of slabs, pavement, and other at-grade and below-grade structures from the excavation footprint. There should be no on-going costs for operations and maintenance of the remedy, and no costs for decommissioning the remedy. Costs for a repeat of ISS, if necessary, are not included.

A breakdown of these implementation costs is provided in Appendix B.

Soil Remedy Alternative S3—Excavation with Off-Site Disposal as Solid Waste

Excavation with off-site disposal could be completed under an area-wide approach over a period of approximately 14 months. If the focused "hot spot" approach was utilized, the work area would be much smaller, and the timeframe would be much shorter—approximately 4 months.

Because the soil COCs within the excavation area would be completely and permanently removed from the Facility, direct contact and vapor intrusion risks would be eliminated or soils within the excavation area. The removed soils would also no longer function as a source of groundwater contaminants. As with ISS, excavation will likely not, however, result in an immediate reduction in groundwater COC levels. It will likely require a period of years to observe water quality improvements in the Perched Zone, and potentially even longer in the Alluvial Aquifer.

It should also be noted that this approach will not mitigate the presence of soil COCs outside the specific excavation area. Unless all of the areas exhibiting elevated soil COC levels at the Facility are removed, therefore, soil COCs will remain present both as potential risk issues and as potential sources of groundwater contamination.

In summary, excavation with off-site disposal would have good short- and long-term effectiveness in reducing risk issues associated with direct soil contact, and good long-term effectiveness (but not short-term) in reducing groundwater COC levels.

The cost to perform excavation with off-site disposal under the area-wide approach depicted in Figure 9A is $50.0 Million, and under the focused “hot spot” approach depicted in Figure 9B is $11.9 Million. Note that these costs do not include the costs of removing buildings and aboveground structures, since those demolition costs are addressed elsewhere (see Section 7.0 of this FS). These excavation costs do include, however, the removal of slabs, pavement, and other at-grade and below-grade structures from the excavation footprint. There should be no on-going costs for operations and maintenance of the remedy, and no costs for decommissioning the remedy.

A breakdown of these implementation, annual, and decommissioning costs is provided in Appendix B.

Soil Remedy Alternative S4—Soil Vapor Extraction

The short-term effectiveness of SVE as a remedy at the Facility will likely be poor, due to two factors:

- The Facility soils have a low permeability, so vapor removal from those soils will be slow. This means that the times required to achieve reductions in COC levels in soils and Perched Zone groundwater will be longer than those for a site with more permeable soils.

- SVE is primarily effective on volatile organics, and would not be expected to have any significant effect on the semivolatile or metal COCs present in soils and shallow groundwater.

Over the long-term, by contrast, SVE will likely have good effectiveness in reducing VOC levels in soils, which would be expected to result in a long-term reduction in levels of those COCs in underlying Perched Zone and Alluvial Aquifer groundwater. By reducing VOC mass, SVE will also be effective over the long-term in reducing the potential for vapor intrusion-based risks associated with Facility soils.

At this Facility, SVE would be difficult to implement on an area-wide basis (i.e., for all areas where elevated VOCs are observed). Under such an area-wide approach, as shown in Figure 10A, SVE would require an extremely large number of wells, with a correspondingly large and complex piping system to connect all those wells to the vacuum pumps. The result would be a widespread and complicated structure that would be difficult to maintain and repair.

In addition, the presence of these wells and piping would potentially interfere with other remedy activities, such as soil cover construction and building demolition. This could require that the implementation of an area-wide SVE system be delayed until after other remedy elements are completed. The SVE system would also significantly impede any reuse of the portion of the Facility being treated with SVE. All of these factors would be less of a concern for SVE implementation across a localized area, as in the focused approach shown in Figure 10B.

The installation of the SVE system for the area-wide approach would require approximately 9 months. Approximately 5 months would be required to construct the SVE system for the focused approach. Because SVE removes COCs from soils, the improvements observed by SVE would be permanent.

In summary, SVE used in a localized approach to treat specific VOC source areas would likely have good long-term effectiveness in reducing both soil and groundwater concentrations of those VOCs, and reducing vapor intrusion-related risks. An area-wide approach, in contrast, would be difficult to implement and maintain and would interfere with both site reuse and potentially other remedy activities. This approach is therefore considered to have poor effectiveness.

The cost to install an area-wide SVE system across all locations with elevated VOCs (see Figure 10A) is approximately $6.2 Million. This cost includes costs for permitting and for installation of an air emissions treatment. For treatment of the two elevated 1,2-DCA source areas at Unit 6 and Units 4/5, a more localized SVE system (see Figure 10B) would cost approximately $1.4 Million. Because this is a smaller system, these costs assume that emissions could be addressed without any exceptional permitting effort, and without emissions treatment.

Annual operations and maintenance costs are estimated to be approximately $1.4 Million for the area-wide approach, and approximately $517,000 for the focused approach that targets 1,2-DCA source areas. Decommissioning, including plugging and abandonment of all extraction wells, and removal of all piping and systems, would require approximately $951,000 for the area-wide approach, and approximately $375,000 for the 1,2-DCA source area approach.

A breakdown of these implementation, annual, and decommissioning costs is provided in Appendix B.

Soil Remedy Alternative S5—No Further Action

In their current condition, soils contain areas with levels of COCs that exceed criteria for safe exposure. In addition, soils are believed to be an on-going source of COC contribution to the underlying Perched Zone and Alluvial Aquifer groundwater. Finally, soils could be a source of vapor intrusion risks for future construction within portions of the Facility. In short, there are soil conditions at the Facility that should not be allowed to remain in an untreated or uncontrolled condition.

An NFA approach would have no short- or long-term effectiveness in addressing these conditions.

Because no action would be taken to address soil COCs or exposures, there would be no implementation, operations, or decommissioning costs associated with NFA.

IV. Justification for Selection:

Given the varied sources of contamination found throughout the on-site soils in the process area, the optimum approach was to use the different remedial alternatives for specific areas. The following remedial alternatives were chosen to address contamination in contaminated areas:

Soil Remedy Alternative S1 – Exposure Controls: This method was chosen

V. Selected Remedy/Site Plan: